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Environmental Restoration Project Quality Procedure

for Sampling of Subatmospheric Air



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Sampling of Subatmospheric Air

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List of Acronyms and Abbreviations

DCC	Document Control Coordinator	QP	quality procedure
ER	environmental restoration	QPPL	Quality Program Project Leader
LANL	Los Alamos National Laboratory	SOP	standard operating procedure
PPE	personal protective equipment	SSHASP	site-specific health and safety
FTL	Field Team Leader		plan
FTM	Field Team Member	SSO	Site Safety Officer

Sampling of Subatmospheric Air

1.0 PURPOSE

This standard operating procedure (SOP) states the responsibilities and describes the process of sampling subatmospheric air from vapor ports in monitoring wells and boreholes for the Los Alamos National Laboratory (LANL) Environmental Restoration (ER) Project.

Note: This SOP is applicable for any collection of subsurface air samples for either field screening or fixed analytical laboratory analysis.

2.0 SCOPE

2.1 All **ER Personnel** shall implement this mandatory SOP for sampling subatmospheric air from vapor ports in monitoring wells and boreholes.

2.2 Subcontractors performing work under the ER Project's quality program shall follow this SOP.

OR

2.3 **Subcontractors** may use the subcontractor's procedure as long as the substitute meets the requirements prescribed by the ER Project Quality Management Plan, and the ER Project's Quality Program Project Leader (QPPL) and an ER technical staff person approve the procedure before the subcontractor begins the designated activity.

3.0 TRAINING

3.1 **ER Personnel** shall train (i.e., read only training) to and use the current version of this SOP; contact the author if the SOP text is unclear.

3.2 **ER Personnel** using this SOP shall document training in the ER training database located at <http://erinternal.lanl.gov/Training/login.asp> in accordance with QP-2.2.

3.3 The responsible **supervisor** shall monitor the proper implementation of this procedure and ensure that the appropriate personnel complete all applicable training assignments.

4.0 DEFINITIONS

4.1 *Absolute pressure*—Pressure measured with reference to absolute zero pressure (as opposed to atmospheric pressure), usually expressed as kPa, mmHg, or psia.

- 4.2 *Adsorbent columns*—These columns that contain adsorbents, such as silica, that are analyzed to determine the concentration of the absorbed constituents. (e.g., subsurface water vapor analyzed for tritium concentrations).
- 4.3 *B&K gas analyzer*—A portable photoacoustic multigas analyzer that is used to detect and quantify gaseous organic concentration in air.
- 4.4 *Carbon dioxide meter*—A meter that is used to quickly and efficiently determine the CO₂ levels of subsurface air.
- 4.5 *Calibration gas*—Three Laboratory-certified organic gas mixes, differing in concentrations of trichloroethane (TCA), trichloroethylene (TCE), and tetrachloroethane (PCE), Are used for B&K operational checks.
- 4.6 *Gauge pressure*—A measured pressure that is greater than ambient atmospheric pressure (as opposed to absolute pressure). Zero gauge pressure is equal to ambient atmospheric (barometric) pressure. Gauge pressure is usually expressed as kPa, mmHg, or psig.
- 4.7 *Packer sample system*—Sampling system that uses inflatable bladders to seal off a desired interval in an open borehole, or at the end of drill casing, in order to obtain a sample from a discrete section.
- 4.8 *Sample train*—An instrument that consists of a power source, an inlet line, an outlet line, a valve, a purge pump, and a CO₂ meter, that provides an interface with the vapor port or connects to the sampling line on the packer system.
- 4.9 *Site-specific health and safety plan (SSHASP)*—Health and safety plan that is specific to a site or ER-related field activity that has been approved by an ER health and safety representative. This document contains information specific to the project including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.
- 4.10 *Subatmospheric air*—The air that occupies open pore space in soil, sediment, or rock beneath the ground surface.
- 4.11 *SUMMA canister*—A canister that is specially treated (e.g., evacuated to a negative pressure of approximately 25 in Hg) using the SUMMA passivation process. The SUMMA canister is used as a passive collection and containment system of laboratory-quality air samples.
- 4.12 *Tedlar bag*—A gas-sampling container fitted with an inert valve and used to collect and contain gases. The bag contains calibration gas for the B&K operational check.

4.13 *Vapor port*—A vapor port is tubing that extrudes from ports on top of the borehole. Each port corresponds to a different depth within the borehole.

5.0 RESPONSIBLE PERSONNEL

The following personnel are responsible for activities identified in this procedure:

- ER Personnel
- Field Team Leader
- Field Team Member
- Site Safety Officer
- Subcontractor
- Supervisor
- User

6.0 BACKGROUND AND PRECAUTIONS

ER Personnel shall use this SOP in conjunction with an approved SSHASP.

Note: All activities described in this section are performed by a **field team member (FTM)**, unless otherwise specified.

6.1 Background

6.1.1 This section provides a more detailed description of the functionality of each component of the system. Each part of the subatmospheric sampling equipment described below has a vital function.

6.1.2 The sample train is the primary component of the subatmospheric air-sampling system. It provides an interface with the vapor port or downhole packer sampling system. Several sampling instruments are necessary for subsurface air sampling.

6.1.3 The B&K multigas analyzer quantifies gaseous concentrations of several contaminants in the subsurface air sample.

6.1.4 The SUMMA canister captures and contains an air sample for transport to an analytical laboratory.

6.1.5 The adsorbent column captures and contains water for tritium analysis by an analytical laboratory.

6.2 Sample Train

6.2.1 The sample train interfaces the purge pump and the sampling equipment with the vapor ports.

- 6.2.2 There are two distinct operational functions of the sample train: the purge cycle and the sampling cycle.
- 6.2.3 Before each sampling cycle, vapor ports must be purged of stagnant air in the line.
- 6.2.4 Purging the line ensures that the sample taken is representative of the subsurface air at depth; every sampling activity must include a purge cycle.
- 6.2.5 After purging the line, the sample train is available to interface with the sampling equipment.
- 6.3 B&K Sampling
 - 6.3.1 The B&K multigas analyzer screens air for organic gaseous concentrations. Six factory-installed optical filters within the B&K determine which gases may be analyzed.
 - 6.3.2 In the ER Project, the six gases are as follows: TCA, TCE, Freon-11, PCE, CO₂, and water vapor.
 - 6.3.3 The instrument quantifies and displays the concentrations of the six gases. Data displayed on the B&K is in units of parts per million (ppm).
 - 6.3.4 Before each day's sampling activities, the B&K must be tested for operational efficiency by an operational check. The B&K is quick and efficient, making it an ideal instrument for determining extent of contamination in the field.
- 6.4 SUMMA Sampling
 - 6.4.1 The SUMMA canister is an evacuated vessel used for collecting and containing analytical quality air samples.
 - 6.4.2 The low pressure inside the canister pulls air inside until a neutral pressure has been achieved.
 - 6.4.3 The manufacturer certifies the canisters to be devoid of contaminants, and the inside of the canister is nonreactive in order to preserve the integrity of the air for analysis.
- 6.5 Adsorbent Column Sampling
 - 6.5.1 Tritium levels in soil water vapor can easily be collected and contained for analysis when using silica as an adsorbent.
 - 6.5.2 Water vapor is adsorbed onto the silica when subsurface air is pulled through the column.

- 6.5.3 After a sample of subsurface water vapor has been collected, the column is removed from the system and is sealed, providing both a collection and containment vessel.
- 6.5.4 The sealed columns may then be sent to an analytical laboratory for analysis.
- 6.6 Packer Sampling System
 - 6.6.1 The packer sampling system may be used in an open borehole or at the end of a borehole when no vapor ports are available to connect to the Sample Train.
 - 6.6.2 An inflatable packer seals off an area in which a vapor sample is desired and then is connected to the sample train.
- 6.7 Precautions and Safety Issues

Note: All activities described in this section are performed by a **FTM**, unless otherwise specified.

 - 6.7.1 Follow properly documented field procedures to ensure that wells and boreholes do not become damaged or contaminated during sampling activities.
 - 6.7.2 Waste generated from sampling activities must be handled in accordance with SOP-1.06.
 - 6.7.3 Personnel safety procedures, such as safety practices and site-specific requirements determined by the **Site Safety Officer (SSO)** and the SSHASP shall be observed to prevent exposure to hazardous materials and physical hazards.
 - 6.7.4 This procedure requires the use of compressed-gas cylinders, pumps, and field-screening instruments.
 - 6.7.5 All equipment and materials must be handled in a safe manner consistent with the limitations stated by the manufacturer.
 - 6.7.6 Carefully read all warning labels associated with the equipment.
 - 6.7.7 Obtain a material safety data sheet (MSDS) for all compressed gases and reagents from the SSO or manufacturer.
 - 6.7.8 The **Field Team Leader (FTL)** shall ensure all field team members have reviewed the MSDS of each gas before starting sampling operations.
 - 6.7.9 Vapor ports extend from the borehole cover and are connected to lines that descend through boreholes. Care should be taken when handling the vapor ports.

- 6.7.10 Because of the harsh conditions in the field, the plastic tubing of the ports may degrade over time, depth tags on the vapor port may become unreadable, or plugs may be lost. Document any unusual conditions of the vapor ports in the field logbook.
- 6.7.11 Special care should be taken during the installation of the adsorbent columns into the sample train.
- 6.7.12 The adsorbent columns should be handled carefully to minimize exposure to ambient air because of contamination that might be present.
- 6.7.13 The adsorbent columns must be properly oriented in the train so that the air stream flows into the column through the designated inlet line.
- 6.7.14 Radon contamination is present on some of the vapor ports. Invariably radon will collect on the vapor ports because the plastic has a slightly negative static charge.
- 6.7.15 When connecting the ports to the sample train, the field team member may receive a radon dose, particularly from vapor ports at ground level.
- 6.7.16 The human body has a slight positive charge, and because of contact with the vapor ports, the hands may attract minute amounts of radon. Simply clapping the hands to relieve any built-up static charge may alleviate this problem.
- 6.7.17 Before lowering the Packer system into a borehole, the borehole must be checked for any irregularities in the borehole, which may cause damage to the system, either blockage in the borehole, which may cause the system to become stuck or areas of the borehole, which may be a larger diameter than the packer can seal causing the packer to burst. This may be done with a down-hole camera system.

7.0 EQUIPMENT

Note: This section describes the equipment and discusses its advantages, disadvantages, and limitations. Refer to the background section for a description of the operational functionality of each field-sampling instrument.

7.1 Sample Train

- 7.1.1 The sample train consists of a power source, an inlet line, an outlet line, a valve, a purge pump, and a CO₂ meter.

- 7.1.2 The power source is a four-outlet surge protector at 120 V AC that powers the purge pump, the CO₂ meter, and the B&K.
- 7.1.3 The inlet line interfaces with the vapor ports by plugging into and onto the ports.
- 7.1.4 The outlet line sends air to the sampling equipment.
- 7.1.5 The valve switches the inlet line between the purge pump and the outlet line.
- 7.1.6 The purge pump pulls subsurface air into the CO₂ meter.
- 7.1.7 The meter displays the CO₂ levels of the subsurface air.
- 7.1.8 When CO₂ levels stabilize, the subsurface air in line is sampled.
- 7.1.9 Most sampling devices can be utilized for subsurface air sampling using the sample train.
- 7.1.10 The sample train is a delicate device. The tubing can kink and allow areas for contaminants to gather and contaminate sampling. The tubing must also remain free of dirt and debris that may foul or plug the inlet/outlet lines.
- 7.1.11 Once sampling is complete, the lines must be purged for 10 to 15 minutes to remove contaminants within the system.
- 7.1.12 To ensure valid results, nonmetal tubing must be replaced between sampling events. Replacement of the tubing must be documented in the field logbook.
- 7.1.13 If tubing was not been replaced after the previous sampling event, it must be replaced and the replacement documented in the field logbook before quarterly sampling activities begin.
- 7.2 B&K Photoacoustic Multigas Analyzer
 - 7.2.1 The B&K analyzer quantifies gaseous concentration of six constituent gases in air samples.
 - 7.2.2 The analysis cycle lasts approximately two minutes and consists of an internal purge, a sampling event, an analysis event, and finally a display.
 - 7.2.3 The internal purge expels all the previous sample air within the analysis chamber.
 - 7.2.4 The sampling event draws a new air sample into the analysis chamber.
 - 7.2.5 The analysis event is the photoacoustic interaction between the air and the infrared light within the analysis chamber.

- 7.2.6 The analysis chamber is a vessel that houses an optical filter and a microphone.
- 7.2.7 The filter allows infrared light to pass into the air sample.
- 7.2.8 The microphones listen for the photoacoustic interaction.
- 7.2.9 The internal computer quantifies the analysis, and then the instrument displays the results.
- 7.2.10 The B&K must be tested for functionality by an operational check before field-sampling events begin.
- 7.2.11 The B&K should avoid the following conditions or events that may hinder performance.
- 7.2.12 The B&K is temperature sensitive and must be protected from thermal trauma.
- 7.2.13 The microphones make the B&K shock sensitive; hence, the B&K must avoid intense physical trauma.
- 7.2.14 The B&K tubing must remain free of debris and dirt that can foul the internal pumps and the internal air filters.
- 7.3 SUMMA Canisters
 - 7.3.1 The SUMMA sample canister is a stainless steel canister evacuated to a negative pressure of approximately 25 in Hg. The passivation process of the stainless steel canister ensures that it will not react with constituents in the sample.
 - 7.3.2 The low pressure of the canister also eliminates the need for a pump to draw the sample.
 - 7.3.3 The stainless steel design and evacuation provide a simple, efficient method for providing an analytical-quality subsurface air sample.
 - 7.3.4 The connection of the SUMMA canister to the sample train must not be compromised. A pressure valve and vacuum gauge help ensure there are no leaks in the system.
 - 7.3.5 The pressure valve and vacuum gauge also regulate the rate and duration of air collection into the canister.
 - 7.3.6 The vacuum gauge aids in determining if leaks are present in the pressure valve, a well port is blocked, or if the SUMMA is full.
 - 7.3.7 To ensure sample quality, SUMMA canisters must be certified by the contract laboratory as clean and leak free.

- 7.3.8 Certified clean canisters must be obtained through the SMO from the contract laboratory where the samples will be analyzed.
- 7.4 Adsorbent Columns
 - 7.4.1 The adsorbent columns are cylinder containers filled with silica and open at each end.
 - 7.4.2 A pump pulls air through the silica. Water vapor from the subatmospheric air adsorbs onto the silica surface.
 - 7.4.3 After more than five milliliters of water (5 gm) has been collected, the column is sealed at each end. The column provides both collection and containment vessel.
 - 7.4.4 The silica, once placed in the column, must not be exposed to ambient air. Excessive exposure to ambient air may allow ambient water vapor to collect thus spoiling the adsorbent column sampling.
 - 7.4.5 The ends of the columns must immediately be sealed after sample collection is complete.
 - 7.4.6 The mass of the column is vital for analysis.
 - 7.4.7 The mass of the column must be measured before field activities begin or immediately before sampling. Take note of the mass of the column plugs as well. A sufficient volume is collected when the mass is increased by more than five grams.
- 7.5 Boreholes and Vapor Ports
 - 7.5.1 Boreholes are deep wells that have six to eight vapor ports.
 - 7.5.2 Borehole identification numbers are typically stamped or displayed on the lid.
 - 7.5.3 The ports protrude from the top of the borehole cap and are labeled to identify the depth of the port. Each port has an extruding section of plastic tubing for connection with the sample train.
- 7.6 Packer Sampling System
 - 7.6.1 The packer system is a system consisting of a reel with measured and marked airlines and electrical wires that connect the downhole packers with the surface controls.
 - 7.6.2 A laptop computer is used to control the downhole interment package when manual controls are not used.
 - 7.6.3 A generator is used to supply power when needed.

- 7.6.4 An air compressor is utilized for inflating the packers.
- 7.6.5 There are many different sizes of packers for different size boreholes.
- 7.6.6 The system also has a sample line, which is made with a material that will not cause cross contamination in the sampling process.
- 7.6.7 The packer system is used in an open borehole to sample a discrete interval by sealing off above and below the sampling interval with the inflatable packers.

8.0 PROCEDURE

8.1 Deviations to SOPs

The **FTL** shall ensure that any deviations from this SOP are documented in accordance with QP-5.7 and/or SOP-01.01.

8.2 Documenting Field Activities

The **FTL** shall ensure the documentation of all field logbook entries in accordance with QP-5.7.

8.3 Presampling Activities

The **FTM** shall perform the following presampling activities:

- 8.3.1 Identify appropriate sampling techniques to be used (the B&K samples to determine the extent of contamination of chlorinated organic vapor in the subsurface air, the SUMMA canisters to collect laboratory-quality air samples and contain them for shipping, or the adsorbent columns to sample subsurface water vapor in subsurface air).
- 8.3.2 Inspect all tubing, fittings, and valves on the sample train.
- 8.3.3 Inspect Swagelok fittings for degradation.
- 8.3.4 Tighten, as necessary, all fittings and valves that make up the assembly.
- 8.3.5 Ensure that the power supply is functional.
- 8.3.6 Perform B&K operational check, if needed.
- 8.3.7 The purpose of the operational check is to introduce a laboratory-certified organic gas mixture to the B&K to check the unit for functionality.
- 8.3.8 Three mixes of the calibration gas are sampled by the B&K.

- 8.3.9 If the B&K reports a concentration equal to or better than 80% of the laboratory-certified concentration, then the B&K is considered functional.
- 8.3.10 If the B&K operational check does not quantify the results of the analysis within 80% of the laboratory-certified concentrations, several actions may be taken to improve performance, such as
- changing the setup parameter (refer to B&K 1305 operational manual for instructions);
 - inspecting the Tedlar bags (bags may degrade and fail over time and allow leaks); or
 - calling the manufacturer (California Instruments) at (714) 974-5560.
- 8.3.11 Before operating the B&K unit, read the operational instruction manual of the B&K 1305 unit.
- 8.3.12 Setup conditions of the B&K may need changing from time to time.
- 8.3.13 Refer to the B&K 1305 operational manual for definitions of error messages.
- 8.3.14 Ensure that the following equipment is available:
- B&K unit
 - CGA 590 bolt compressed gas regulator
 - Three Tedlar bags
 - A large adjustable wrench
 - A length of one-quarter-inch Teflon tubing
 - One-quarter-inch Swagelok fittings (bolts, ferrules, collets)
 - Calibration gas, representative of the expected compounds and concentration ranges
- 8.3.15 Inspect the on/off switch, the functional buttons, power cord, the inlet line and the outlet line.
- 8.3.16 Ensure the B&K has a functional power source.
- 8.3.17 The first step in the operational check is to fill the Tedlar bags.
- Note:** The Tedlar bags are to be filled with gases contained in pressurized tanks. Take great care when handling the pressurized tanks.
- 8.3.17.1 Identify the concentration of the calibration gas.

- 8.3.17.2 Confirm that the calibration gas concentration and the Tedlar Bag calibration gas concentration label agree.
- 8.3.17.3 Each bag should only be used for a specific gas mix.
- 8.3.17.4 Ensure that the regulator valve is closed.
- 8.3.17.5 Then connect the regulator to the calibration gas bottle, and connect the Tedlar bag to the regulator.
- 8.3.17.6 Open the valve on the Tedlar bag and the valve on the bottle.
- 8.3.17.7 Slowly open the regulator valve and fill the Tedlar bag. Close the regulator valve, the Tedlar bag valve, and then the bottle valve.
- 8.3.17.8 Remove the Tedlar bag from the regulator.
- 8.3.17.9 Open and close the regulator valve to release any gas within the regulator.
- 8.3.17.10 Remove the regulator from the gas bottle.
- 8.3.17.11 Repeat action steps 8.3.17.1 through 8.3.17.7 by filling the other Tedlar bags with the other calibration gas mixtures.
- 8.3.18 The second step in the operational check is to perform the B&K calibration.
 - 8.3.18.1 Turn on the B&K.
 - 8.3.18.2 Connect a Tedlar bag to the B&K inlet line.
 - 8.3.18.3 Open the Tedlar bag valve.
 - 8.3.18.4 Begin continuous monitoring of the B&K. Refer to the B&K manual for B&K operation instructions.
 - 8.3.18.5 Allow the B&K to take several samples of gas from the Tedlar bag.
 - 8.3.18.6 Observe the B&K gas concentration display. The goal is to achieve concentration values equal to or greater than 80% of the laboratory-certified concentrations of the calibration gas mix.
 - 8.3.18.7 Document the operational check results into the field logbook.
 - 8.3.18.8 Close the Tedlar bag valve, and remove it from the inlet line.

- 8.3.18.9 Repeat action steps 8.3.18.2 through 8.3.18.8 using the next calibration gas mix.
 - 8.3.18.10 Document the six gas concentration values of each calibration gas mix (there are three) in the field logbook under the B&K operational check.
 - 8.3.19 Document the following presampling activities into the field logbook:
 - Sample train inspection
 - Calibration
 - Port conditions
 - Tubing problems/solutions
 - B&K operational check
 - 8.3.20 If a packer system is used for sampling, check the inflatable packers and airline fittings for leaks before it is sent down hole.
 - 8.3.21 Mobilize to site.
- 8.4 Sampling Activities

The **FTM** shall perform the following sampling activities:

 - 8.4.1 Confirm borehole number and location.
 - 8.4.2 Document commencement of sampling activities in field logbook.
 - 8.4.3 Identify and correlate borehole number with field logbook borehole number.
 - 8.4.4 Inspect the vapor port.
 - 8.4.5 Document any abnormal conditions of the vapor port in the field logbook.
 - 8.4.6 Purge the sample train for approximately 10 to 15 minutes with the purge pump to remove all stagnant air within the tubing and valves.
 - 8.4.7 Connect the sample train inlet line to the vapor port.
 - 8.4.8 Begin one of the specific sampling activities below.
- 8.5 B&K Sampling

The **FTM** shall perform the following B&K sampling activities:

 - 8.5.1 Disconnect the B&K inlet line from the sample train.
 - 8.5.2 Ensure that the B&K is in *Continuous Monitoring* mode.

- 8.5.3 Press *Standby* button on B&K control display; this starts the sampling cycle.
- 8.5.4 Allow the B&K to take three ambient air readings, and record gas concentrations for each in the field logbook.
- 8.5.5 Press *Standby* button; this stops the sampling cycle.
- 8.5.6 Connect the B&K inlet line to the B&K outlet of the sample train.
- 8.5.7 Ensure that the sample train valve is turned to *Purge*.
- 8.5.8 Ensure that the CO₂ meter inlet line is connected to the purge pump outlet line and is operating.
- 8.5.9 Activate the purge pump and purge vapor port to depth.
- 8.5.10 Observe the CO₂ measurement carefully while purging the line.
- 8.5.11 When the CO₂ level stabilizes, read and record the measurement into the field logbook.
- 8.5.12 Deactivate the pump and quickly turn the sample train valve from *Purge* to *B&K*.
- 8.5.13 Press the *Standby* button on the B&K control panel to start the sampling cycle.
- 8.5.14 Record the measurement of the B&K analysis and the current date/time in the field logbook.
- 8.5.15 Press *Standby* button to stop the sampling.
- 8.5.16 Disconnect sample train inlet line from vapor port.
- 8.6 SUMMA Sampling

The **FTM** shall perform the following SUMMA sampling activities:

 - 8.6.1 Ensure that action steps 8.4.1 through 8.4.6 are completed.
 - 8.6.2 Activate purge pump and purge vapor port to depth.
 - 8.6.3 Observe CO₂ measurement carefully while purging the line.
 - 8.6.4 When the CO₂ level stabilizes, read and record measurement into field logbook.
 - 8.6.5 Disconnect the sample train from the vapor port.
 - 8.6.6 Connect pressure valve with the vacuum gauge to the vapor port; ensure all valves are closed.
 - 8.6.7 Attach SUMMA canister to pressure valve.
 - 8.6.8 Open the valve on the SUMMA canister, and check the vacuum gauge for proper vacuum.

- 8.6.9 Open the pressure valve; the SUMMA canister will draw an air sample because of the vacuum in the canister.
- 8.6.10 Close the valve on the canister when the gauge indicates that the pressures in the canister and atmospheric pressure have equilibrated.
- 8.6.11 Complete the identification tag of the canister.
- 8.6.12 Document SUMMA sampling in the field logbook, in the sample collection log, and on the chain of custody forms.
- 8.6.13 Disconnect pressure valve from vapor port.
- 8.6.14 Store the canister in the shipping container and ship to the Laboratory SMO, according to SOP 01.03.

8.7 Adsorbent Column Sampling

The **FTM** shall perform the following adsorbent column sampling activities:

- 8.7.1 Ensure that action steps 8.4.1 through 8.4.6 are completed.
- 8.7.2 Measure the mass of the adsorbent columns before field activities, and document in the field logbook.
- 8.7.3 Activate purge pump and purge vapor port to depth; observe CO₂ measurement carefully while purging the line.
- 8.7.4 When the CO₂ level stabilizes, read and record measurement into field logbook.
- 8.7.5 Connect the adsorbent column to the exhaust of the sample train.
- 8.7.6 Activate pump to pull air through the adsorbent column until the mass of the column is increase by at least five grams.
- 8.7.7 Quickly remove column, and seal the ends.
- 8.7.8 Document adsorbent column sample in the field logbook, in the sample collection log, and on the chain of custody.
- 8.7.9 Submit samples to the Laboratory SMO in accordance with SOP-01.03.

8.8 Sampling Through the Packer System

The **FTM** shall perform the following sampling through the packer system activities:

- 8.8.1 Connect proper size packer along with the desired separation between packers (if using two packers) and record information in logbook.
- 8.8.2 Lower packer(s) to desired depth; record information in logbook.

8.8.3 Inflate packer(s) to desired pressure.

8.8.4 Note pressure in logbook and continue to monitor pressure throughout the sampling process.

Note: The packer pressure should remain above one pound/inch² (psi). If pressure drops below one psi re-inflate. Low pressure indicates the sample zone may not be isolated.

8.8.5 Connect the sample line to the Sample Train and continue from action step 8.4.3.

8.8.6 Deflate packer(s) before pulling them out of the borehole.

8.9 Post Sampling Activities

The **FTM** shall perform the following post sampling activities:

8.9.1 Dispose of any tubing that is visibly damaged or contaminated.

8.9.2 Purge indicator gas concentrations (i.e., CO₂) should remain constant if the sample stream is free of leaks and a proper purge is achieved.

8.9.3 Ensure quality of the sample by eliminating any leaks within the system.

8.9.4 Whenever connecting two or more gas lines, confirm that the connection is free of visible and audible leaks.

8.9.5 Whenever data quality is questioned or possibly compromised, inspect all connections for leaks.

9.0 LESSONS LEARNED

9.1 Before performing work described in this SOP, **ER Personnel** should go to the Department of Energy Lessons Learned Information Services home page, located at <http://www.tis.eh.doe.gov/ll/ll.html>, and/or the LANL Lessons Learned Resources web page, located at http://www.lanl.gov/projects/lessons_learned/, and search for applicable lessons.

9.2 During the performance of work, ER Personnel, if appropriate, shall identify, document, and submit lessons learned in accordance with QP-3.2.

10.0 RECORDS

The **FTL** shall submit the following records to the Records Processing Facility, in accordance with QP-4.4:

- Completed chain-of-custody/request for analysis form

- Closed out field logbook
- Completed sample collection log

11.0 REFERENCES

To properly implement this SOP, **ER Personnel** should become familiar with the contents of the following documents located at http://erinternal.lanl.gov/home_links/Library_proc.shtml:

- ER Project Quality Management Plan
- QP-2.2, Personnel Orientation and Training
- QP-3.2, Lessons Learned
- QP-4.4, Record Transmittal to the Records Processing Facility
- QP-5.7, Notebook Documentation for Environmental Restoration Technical Activities
- SOP-01.01, General Instructions for Field Investigations
- SOP-01.03, Handling, Packaging and Shipping of Samples
- SOP-10.06, Management of ER Project Wastes

12.0 ATTACHMENTS

Attachment A: Packer System Diagram, 1 page

[Using a token card, click here to record "self-study" training to this procedure.](#)

If you do not possess a token card or encounter problems, contact the RRES-ECR training specialist.

Packer System Diagram

